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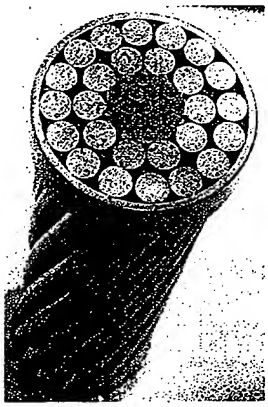
R&D

Where Innovation Begins

41st Annual R&D 100 Awards

Multiplying Transmission Capacity

Rolling blackouts, as evidenced by the East Coast power outage this past August, have caused government and energy suppliers to address the long-standing problem of consumption. Simply put, the grids developed decades ago are fading fast and putting up more lines would only be a temporary fix. Many believe that the answer for energy transmission lies within innovation. This is the theme behind the **3M Composite Conductor**.



Devised by 3M, St. Paul, Minn., along with Preformed Line Products, Cleveland, Alcoa-Fujikura, Franklin, Tenn., Wire Rope Industries, Pointe-Claire, Quebec, and Nexans Canada, Markam, Ontario, this material is a high-temperature, low-sag, bare overhead composite conductor with the ability to double the capacity of overhead transmission lines.

The composite is a combination of heat-resistant aluminum (Al)-zirconium (Zr) strands surrounding an Al composite core. This formulation makes it lighter than conventional conductors, such as Al-steel reinforced conductors (ACSR) and offers a factor of 1.5 to 3 times improved current capacity. Along with enhanced transmission capability, its low-weight enables line upgrades within existing rights-of-way, eliminating costly tower modifications and minimizing environmental impact.

Going beyond energy transmission, the conductor has the potential to serve as a replacement fiber for traditional brake calipers, cutting their normal weight by half.

www.mmm.com Write in 3044

Super Aerogels

The ultra low conductivity, optical transparency, and low-density properties of aerogels have been known for decades. However, their high manufacturing costs and extreme brittleness have prevented their successful commercialization. A research team at Aspen Systems, Inc., and Aspen Aerogels, Inc., both of Marlborough, Mass., and NASA/Kennedy Space Center, Fla., has overcome these two limitations with their **Flexible Aerogel Superinsulation**.

The basis of their product is a flexible aerogel blanket. During processing, aerogel materials are placed into a fiber-based batting before being fully encased around the blanket fibers. When the blanket is flexed, discrete domains of the aerogel material remain embedded in the blanket, maintaining all the performance benefits of the monolithic aerogel.

The current marketed product line consists of three types of blanket insulation to cover a full range of temperature applications. These blankets' typical conductivity, insulation, and density values are two to four times better than competitive conventional materials.

www.aspensystems.com Write in 3046

New Class of Nanomaterials

Researchers at Rice Univ., and Carbon Nanotechnologies, Inc., both in Houston, Texas, have developed **Fluoronanotubes**, a materials precursor for creating new systems of carbon nanotube (CNT)-based products. Produced by a reaction of F_2 and HF mixtures with CNTs at temperatures from 100 to 400° C, fluoronanotubes minimize the tendency of CNTs to self-agglomerate, while at the same time making the product soluble in a wide variety of solvents.

The primary functions of fluoronanotubes are to serve as a precursor with multiple sites 1) for the preparation of derivatized nanotubes using RLi, Grignard reagents, and Li_3N-reactions, 2) for the formation of hydrogen bonds with -OH groups or -NH_2 groups which allow the solvation of CNTs and the formation of stable adducts with peptides and DNA, and 3) for cutting and debundling complex, intertwined CNTs formed in electric arc, combustion, or CO-disproportionate syntheses.

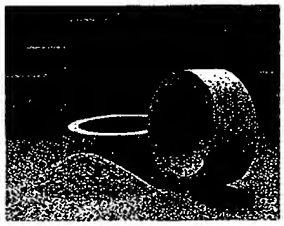
The ability to isolate CNTs by fluorinating them has also permitted them to be more uniformly dispersed in polymer and ceramic composites. Furthermore, the fluorine can be removed from the CNT with a reducing agent, allowing them to serve as a temporary species that merely enables the manipulation of the CNT.

www.rice.edu Write in 3045

Supercold to Superhot Lubricants

PS/PM300 High-Temperature Solid Lubricant Coatings and Composites fill a lubrication void that exists between traditional solid lubricants, such as graphite and molybdenum-based systems which are useful to about 425° C, and exotic narrow temperature range glassy lubricants which work above 800° C. The PS/PM300 contains thermochemically stable, low-temperature solid lubricant additives and high-temperature solid lubricants, which provide lubrication from -185° C to over 900° C.

Developed by Christopher DellaCorte and Brian Edmonds at NASA Glenn Research Center, Cleveland, the PS/PM300 lubricants overcome the drawbacks of its predecessors, namely life and cost. In thermal spray coating form (PS300), it is comparable to the cost of other wear resistant coatings. As a powder metallurgy bushing (PM300), it costs about 10 times that of porous bronze and about the same as graphite or polymers.



The PS/PM300 technology enables previously impractical engineering systems. For example, a PS300 lubricated foil air bearing has been proven in stationary, oil-free microturbine generators. Elimination of the oil system reduces the overall engine cost by 15% and reduces annual maintenance to a simple air filter change. The materials also have applications in different types of valves, as well as high-temperature conveyor systems.

www.grc.nasa.gov/WWW/oilfree Write in 3047